Report from the ALS Division Director

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As you can see from the statistics in Table 2-1, the ALS is really hitting its stride. We expect to host over five hundred users this fiscal year. You may have noticed that the numbers for previous years have changed somewhat. We are now using a uniform DOE definition of a user as "a badged researcher who conducts experiments within the user facility (including facility staff)". Another fact that can be gleaned from the table is that in the eighteen months between the Birgeneau Committee site visit (July 1997) and January 1, 1999, the cumulative station-hour totals for the ALS will double. This is a growth rate that would be impressive even for a Silicon Valley start-up company!

We are now seeing the full effect of the Scientific Facilities Initiative, which boosted funding for the ALS and other DOE national user facilities starting in FY 1996. Continuation of this funding during FY 1997 enabled us to maintain the large increase in the number of operating hours for users and build new beamlines. It is an encouraging sign that maintaining scientific facilities utilization is still among the top priorities for the DOE Energy Research Program in FY99, as this will allow us to continue serving our users effectively.

Table 2-1. ALS usage statistics. The impact of the Facilities Initiative in FY 1996 can be seen clearly in this table.

	FY94	FY95	FY96	FY97	FY98 (Projected)
Users	91	182	184	297	500
Independent Investigator Proposals	0	7	43	168	190
User Hours	2,222	2,686	4,461	4,781	4,500
Operating Beamlines	8	11	14	17	23
Station Hours per Year	17,776	29,546	62,454	81,277	103,500
Cumulative Station Hours	17,776	47,322	109,776	191,053	294,553

In Fall 1997 the ALS became a full division of Berkeley Lab. It is part of the Energy Sciences Directorate, which includes the ALS, the Chemical Sciences Division, the Materials Sciences Division, the Earth Sciences Division, and the Environmental Energy Technologies Division. (The Accelerator and Fusion Research Division, its former parent organization, is in the General Sciences Directorate.) The Berkeley Lab organization chart is on the World Wide Web at

http://www.lbl.gov/Workplace/Lab-Support/org-chart.html

In addition, the ALS has been reorganized to have a better balance between operations and the scientific program. The Experimental Systems Group now reports to the Scientific Program Head, and two new groups for user support and scientific support, respectively, have been created. [Note: In July 1998, the ALS organization changed so that all three of the groups mentioned here report directly to the ALS Division Director. —Editor] This rearrangement should provide a more responsive organization and one that is better structured for user support.

The ALS Science Policy Board was reconstituted and held its first meeting in several years.

A major workshop on Scientific Directions at the Advanced Light Source, with more than three hundred participants from around the world, was held March 23-25, 1998. The areas targeted for rapid development at the ALS included environmental science, protein crystallography, the physics of correlated materials, and biological microscopy, among others. We expect to see proposals in these areas funded in the future, leading to new beamlines and instrumentation at the ALS and new scientific output driven by more ALS users. Please see the ALS web site for more details:

http://www-als.lbl.gov

Progress in Performance and Service

Technical progress has continued to be impressive since my last report. Some highlights are mentioned below.

- We now operate at 1.9 GeV about two-thirds of the time, and we have increased the maximum current available in this mode from 340 mA to 400 mA.
- A small-gap vacuum chamber has been installed in Sector 8, along with an improved first optical element for the undulator beamline. This means that the low end of the undulator spectrum can now be reached without requiring 1.0 GeV operation of the ALS.
- The "camshaft" fill pattern provides for a range of timing experiments without interfering with more conventional uses of the beam, minimizing the number of weeks required for time-of-flight experiments using two-bunch filling mode.
- There has been ongoing work to increase the performance of the storage ring, including studies addressing the following: reduction of vertical emittance, a third-harmonic cavity to increase stored beam lifetime, intermediate-field bends and superbends, and small-gap insertion devices.
- Initial microdiffraction (x-ray diffraction) results using Beamline 10.3.2 have demonstrated a sub-micron x-ray spot, and have already stimulated a rapidly expanding user community in environmental science, materials science, and semiconductor applications. A strong user program pursuing micro-XAS measurements, led by the Earth Sciences Division, has started, and we are in the process of commissioning Beamline 7.3.3, dedicated to time-resolved and micro x-ray diffraction.
- Two new programs in atomic, molecular, and optical (AMO) physics and in the physics of correlated electronic materials will start up later this year on the new Beamline 10.0.1. With major funding coming from the Scientific Facilities Initiative, the high-resolution spherical grating monochromator from Beamline 9.0.1 has been moved to sector 10, a new U10 undulator has just been installed, and new endstations have been constructed.
- The extreme-ultraviolet lithography program is growing, with two new bend magnet beamlines in the works: 11.3.2 for mask testing, and 6.3.1 for independent investigator users.
- The new photoelectron microscope on Beamline 7.3.1.1 has recently come on line. This instrument is to be used under a cooperative research and development agreement with IBM and will serve, among others, a growing consortium of users from Arizona State University and the University of California, Berkeley.
- Several new scientific programs investigating the generation and use of femtosecond time-scale x-ray beams have sprung up around the ALS. This is a new area of work in the field of synchrotron radiation, and may lead to a new kind of fourth-generation light source. With funding from Laboratory Directed Research and Development (LDRD) and outside funding agencies, new programs include using the ALS linac beam and a fast laser to make Compton-scattered x rays, a novel project using laser-induced energy modulation of the ALS electron beam in the wiggler to make fast x-ray pulses, a project to make a fast x-ray switch, and Center for Beam Physics work on chirped pulse x-ray generation.
- Beamline 5.0.2 for macromolecular crystallography was completed in the fall of 1997, and in just several months has resulted in a 25% growth in our overall user community. Data sets typically take 2_3 hours to obtain, and high-quality, complete structural data is often taken in

less than 24 hours; a number of important protein structures have been solved. Complete data sets have been taken on crystals as small as 40 x 30 x 5 μm. We expect approximately an order-of-magnitude improvement in performance once our permanent optics are installed later this year. Microfocusing optics have been developed and tested to increase the vertical flux density by a factor of 7, reducing the vertical beam size to 35 μm. We are currently designing and building the next crystallography line, 5.0.1, with a curved crystal focusing monochromator.

- The LIGA lithographic technique is now up and running on Beamline 3.3.2, and a PRT consisting of groups from Sandia National Laboratory, the Jet Propulsion Laboratory, and Berkeley Lab is forming.
- A prototype superconducting bend magnet for the ALS has been successfully completed after a three-year research and development project, paid for with LDRD funds. The idea here, originally due to the ALS's Alan Jackson, is to replace three of the present 36 bend magnets with high-field superconducting magnets. This can be done without compromising the present excellent performance of the ALS, resulting in as many as 12 new beamlines that have excellent high-brightness performance—equivalent to bending magnet sources at the APS, ESRF, and SPRING-8 at considerably lower cost. This innovation would make the ALS a "universal" light source. This project has strong backing from the crystallography community, and will extend the range and applicability of ALS for materials science. The Science Policy Board also gave its blessing to this new direction.
- A working scale model for the EPU insertion device, which shifts rows of magnets to produce light in any polarization from linear to circular (either helicity), was recently measured and found to meet specifications. The first EPU will serve branchline 4.0.1-2, to be dedicated to magnetic spectroscopy , and scheduled to be commissioned in September 1998.

This is really an amazing list of accomplishments, and shows what a talented and well-integrated team we are fortunate to have at the ALS.